Industry 4.0 Competence Model for Malaysia Industry4WRD

Ambigaipagan NAGASAMY
School of Management, Asia e University, Kuala Lumpur, Malaysia
paagan_33@yahoo.co.uk

Wan Fauziah Wan YUSOFF
Faculty of Technology Management and Business,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, Malaysia
fauziahy@uthm.edu.my

Sivan RAJAH
Faculty of Technology Management and Business,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, Malaysia
schruti06@yahoo.com

Abstract

The Fourth Industrial Revolution, one of the most debated and researched topic, with countries and businesses directing their focus and effort towards understanding, cultivating, manipulating, and implementing the new approach. The key is in the digitalisation and automation which creates an advent method to production process, product and service creation, customised consumer products, and business approaches. Hence, the demand for new skillset and competencies with highly technical and complex skills are a prerequisite in order for the organisation to succeed. Therefore, this study intends to propose a competence model for organisation to measure employees' competence in order to achieve the Industry 4.0 transformation. As such, it would be able to provide the necessary competences required to cater for the transformation in Malaysian context. The model can be employed as a diagnostic tool to measure the employees' readiness for Industry 4.0.

Keywords: Fourth Industrial Revolution, Industry 4.0, Competence, Malaysia Industry4WRD

Introduction

The evolution of industrialisation has taken yet another phase owing to the monumental technological innovation and advancement. The latest edition of the industrial revolution, the Fourth Industrial Revolution (IR 4.0) also termed as Industry 4.0 (I4.0) or Industrie 4.0 was initiated in 2011 (Schwab, 2016; Prifti et al., 2017). However, the term Industry 4.0 is considered a niched concept which refers to the transformation that occurs within manufacturing through digitalisation and connected technologies (MITI, 2018). Currently, it is one of the most debated and researched topic. Countries and business entities have directed their focus and effort towards understanding, cultivating, manipulating, and implementing the new approach to industrialisation (Gudanowska, 2017; Santos et al., 2017; Jones & Pimdee, 2017). Responding to this development, the Malaysian government initiated a national policy termed as Industry4WRD (MITI, 2018). The policy focuses on ensuring Malaysian manufacturing industry are prepared for the digital transformation. Malaysian Ministry of International Trade and Industry (MITI) identified 4 key drivers namely: technology, human capital, global trade and network, and institutional framework. These 4 pillars are considered as the enablers that requires emphasis to undertake the transformation.

The key note for the fourth industrial revolution is a highly revolutionised high-end digitalisation and automation (Schwab, 2016) which paves new approaches to production process, product and service creation, customised consumer products, and business approaches (Rojko, 2017; Schwab, 2016; Shamim et al., 2017; Rahman et al., 2017). It is estimated that a total of 20.7 billion digitally connected smart factories would be available and operating by 2020 from only 4.9 billion in 2015 (Celaschi, 2017). This huge number indicates the rate of expansion of industry 4.0 or as put by Bergami (2016) "digital tsunami" (as cited in Celaschi, 2017). The new revolution presents the Cyber Physical System (CPS) that enables the production and business operation that are digitalised and automated (Shamim et al., 2016; Rojko, 2017). Thus, providing "digital enhancement and reengineering of products (Shamim et al., 2016), detailed customised products that precisely serves the customers requirement

(Santos et al., 2017), enhanced digital work environment (Park, 2017; Santos et al., 2017), real time data exchange (Becker & Stern, 2016; Santos et al., 2017) Internet of Things (IoT) and location-based big data (Celaschi, 2017; Park, 2017; Santos et al., 2017).

The new industrial revolution is predicted to reduce labour capital and able to reduce cost of production (Schwab, 2016). Three key elements that are the backbone of the fourth industrial revolution namely knowledge, innovation, and creativity. According to Hoa (2017) the combination of the three elements requires certain degree of effort to ensure success of the transformation. Hoa (2017) indicated the production method and structure, innovativeness must be made a priority, and continuous learning for the workforce. Apart from that, this new skills and knowledge requirement drives the need for a continuous learning (Shamim et al., 2016; Celaschi, 2017; Rahman et al., 2017). Continuous learning is evidently crucial as the transformation requires highly technical and complex skills, whereby it reduces the low skill, repetitive, and routine work (Becker & Stern, 2016; Shamim et al., 2016; Park, 2017). As such, it is evident that new skillset and competences is a major concern in the industrial era (Erol et al., 2016; Gudanowska, 2017; Hecklau et al., 2016; Kergroach, 2017).

Industry 4.0

The monumental development of digital technology triggered yet another revolution since the beginning of the millennium. The ingenuity of the current technological inventions brought about significant changes to the world, with a mere touch, people are able to communicate, connect, trade and educate themselves. This is feasible only due to the advancement of digital technologies that are by far more sophisticated than of the previous centuries (Daemmrich, 2017; Hammes, 2017; Schwab, 2017; Skilton & Hovsepian, 2018).

The world owed Britain for the first industrial revolution, the second revolution and third revolution was both the brainchild of America and the current revolution was actually the initiative of German (Daemmrich, 2017; Schwab, 2017, Rojko, 2017). The Hannover fair in 2011, introduced and presented the concept as new age revolution. The initiative was actually targeted at the manufacturing sectors in German, which was on the brink of a crisis. The government foresaw the need for a new approach to strategically put back German industries on its feet through computerization and innovation of manufacturing (Schwab, 2017, Hammes, 2017).

The current revolution is tied to the development of artificial intelligence, cyber-physical systems, electronic miniaturization, additive manufacturing, and nanotechnology (Hammes, 2017; Daemmrich, 2017). These technologies are the key to the shift in the manner in which (1) technologies are utilised, (2) innovative management, (3) administration of workforce in an organisation, and (4) the manner of consumption (Daemmrich, 2017). Daemmrich (2017) noted that humans are still the key element in the fourth industrial revolution, no doubt that some predict that it would have a horrendous impact resulting in workforce reduction with the massive growth in artificial intelligence.

Furthermore, the revolution is only practicable as the growth in the field of science, technology, and engineering, and not forgetting the shift in management style. However, the key to the revolution is the change in the technology and how innovation is able to cause or trigger a fundamental modification to the already existing order (Daemmrich, 2017). Rojko (2017) pointed out that the concept was only achievable due to four reasons, (1) internet and Internet of Things (IoT), (2) technical and business processes collaboration, (3) digital mapping and virtualisation, and (4) smart industrial production and products.

Competence

The concept of competence dates back right to when the ancient Chinese dynasties introduced civil service examination. At this point, the examination was used to gauge the individual's knowledge, ability, and skills to be part of the government. This gave birth to competence measurement, which means the prospect civil servant need to have a high degree of competence to be able to contribute to high level of performance (Hoge et la., 2005). There are two terms i.e. Competence and Competency, the former refers to the competence functional areas, and the latter refers to behavioural area (Le Deist & Winterton, 2005). Since this research is focused on identifying the required skillsets and knowledge, therefore the term "Competence" is deemed fit.

Competence is considered substantially important and given high consideration due to its ability to provide competitive advantage for organisations. This is as the organisation are able to divert their resources to better fit their aims and achieve it. One of the greatest challenges that workers are known to face is the ever-changing work environment, either brought about by management or the industrial shift in technology or ideology. These shifts have a significant impact on the workers skills requirement and competence. Thus, the need for updating of

knowledge and skills are crucial and this relies heavily on the competence measure (Draganidis & Mentzas, 2006; Paloniemi, 2006; Eilström & Kock, 2008).

According to Olesen (2017), the concept of learning in competence relates to enhancement of human capabilities, which is the process of allowing the knowledge and skills to be imparted in order to uplift the employees' ability and capacity to function to a particular requirement. Olsen (2017) indicated four attributes that relates to competence; (1) ability of the individual to perform a particular job or task successfully, (2) Perform task that are complex, (3) able to perform the task with cognitive and non-cognitive ability, and (4) all of which in relation to their role. In an earlier study conducted by Olesen (2014), he asserted that competence is relevant not only in context of individual organisation but also the nation as whole. Highlighting on the Organization for Economic Cooperation and Development (OECD) definition, which indicated that pre-requisite and competence features need to be in line with the global requirements. Apart from that, competence is also a measure that can be utilised by government around the world to incorporate policies, education system and primarily allow mindset change in the workforce (Olesen, 2014).

Eilström and Kock (2008) stated that competence can be viewed in three perspective; (1) Employee attributes, (2) Job requirement, and (3) Interaction between the employee and task. According to the first perspective, competence is understood as the employee's ability to perform a particular job or task. In which his or her ability is gained through knowledge or skill as a result of either learning or experience, or both (Hoge et al., 2005). The ability or capacity combines both cognitive and non-cognitive (Olsen, 2017). Apart from that, other factors such as personality, intrinsic and extrinsic, and social skills are also considered salient in ensuring the employees competence.

Proposed Model

The need for a competence model that suits Malaysian context in line with Industry 4.0 is evidently crucial. Hecklau et al. (2016) highlighted competence model enables the organisation to fit the current and future employees into achieving the transition i.e. from IR 3.0 to IR 4.0. Although, Schwab (2010) indicated that at this point of time it is still considered at an infant stage and he believes that the need for competence model has not reached a critical stage. However, any form of new revolution that brings about changes that are both colossal and disruptive requires a set of guideline and measurement tool in order to gauge performance and outcome (Judrups et al., 2015; Wee et al., 2015; Prifti et al., 2017; Hecklau et al., 2017). There are a number of competence models that are available which includes four major elements; (1) personal, (2) social/interpersonal, (3) action-related, and (4) domain-related competences. However, for the purpose of this research, Hecklau et al. (2016) competence model will be adapted into Malaysian context. Due to the complexity of the revolution a competence model that is universal in its nature is relevant. According to Longo et al. (2017), Hecklau et al. (2016) competence model is a holistic competence model that satisfies both management system and employees' knowledge and skills. The main objective of the model was to provide firms with the necessary tool to identify and analyse the gap for competences in Industry 4.0 (Hecklau et al., 2016,).

The model was derived through a PESTEL-framework and comparative analysis. The analysis produced 6 categories; political, economic, social, technical, environmental, and legal factors. The latter analysis enable the researcher to eliminate redundancy, hence producing the four main domains, and the required competence. The four domains; (1) technical competence, (2) behavioural (methodological) competence, (3) social competence, and (4) personal competence. The domains of technical competence, basically relates to the employees work or task skills and knowledge. The task skills that are required for the industry 4.0 consist of skills that are in line with automation and digitalisation of the production process. Therefore, knowledge and skills on the latest technology, process, encryption, and security is an essential part of the skills of the future employee (Hecklau et al., 2016; Ng et al., 2016; Jerman, 2018).

The behavioural (methodological) competence refers to the employees' cognitive and metacognitive skills. These abilities are relevant in a high-tech environment which demands solutions within a stipulated time frame. This is basically the cognitive skills of an individual to explore and gain new insight, as such the individual is able to independently employ the learnt knowledge in work task (Mietzner & Kamprath, 2013; Meyer et al., 2015; Eberhard et al., 2017; Gronau et al., 2017).

Social competence refers to the ability an individual has to interact, negotiate, collaborate, or lead in a particular social environment to achieve the desired outcome. All the set of competence enable an individual to coordinate his activities through his social ability to achieve the outcome that the individual, team or organisation requires (Cramer & Zwaal, 2006; Badriyah & Noermijati, 2015; Hecklau et al., 2016; Eberhard et al., 2017). The fourth

domain is personal competence. This refers to the individual's attitudes that cultivates within him the necessary impulse which is projected in his work task or activities (Hecklau et al., 2016; Eberhard et al., 2017; Gronau et al., 2017). The social competence is how the individual connects to the external factor, on the other hand the personal competence is the individual's internal factors that contributes to how he or she is able to perform particular task (Mietzner & Kamprath, 2013).

Hence, the proposed model (see Figure 1) will adapt the domains, and the competence for each of the domains will be explored and identified to accommodate the local context.

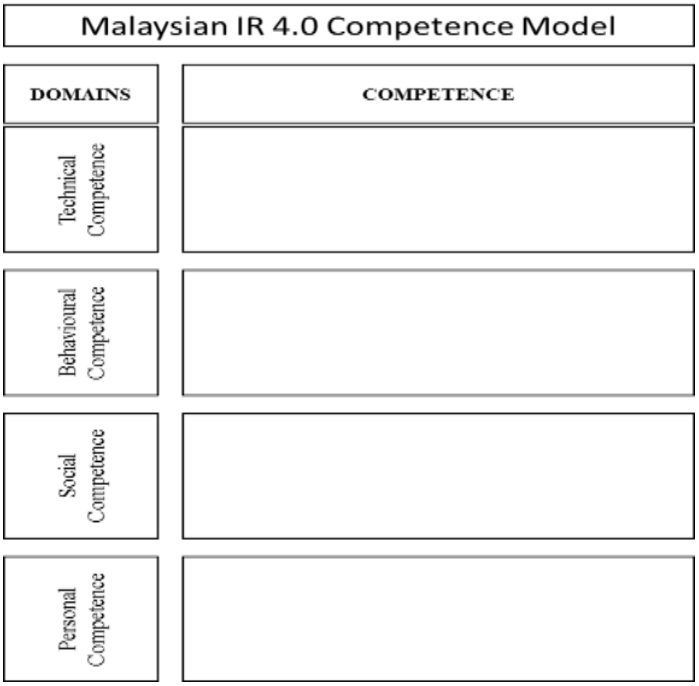

Figure 1: Competence Model Metrics
Adapted from Hecklau et al., 2016

Conclusion

The concept of industrial revolution is known to bring about new approaches to production processes as well as the shift in workforce knowledge and skillsets. Hence, the Industry 4.0 requires employees to have a new skillset and competences, thus it is necessary to identify competences that is able to cater for the transformation. This research proposes a Malaysian Industry 4.0 Competence Model in order to guide organisations to take up the job profile shift and the Industry 4.0 challenges, in line with Malaysian Industry4WRD.

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